United States Environmental Protection Agency **Office of Research and Development**

National Exposure Research Laboratory
Research Abstract
Government Performance Results Act Goal: Safe Food

Significant Research Findings:

Minnesota Children's Pesticide Exposure Study (MCPES)

Scientific Problem and Policy Issues	Biological monitoring is often completed as part of exposure or health surveys. These results may be used to represent aggregate exposure, which refers to the total exposure of humans to a single chemical through all relevant pathways and routes. The interpretation of these measurements requires information about the when, how, and for how long the exposures occurred; and how quickly the chemical is absorbed into and removed from the body. In addition, since biological fluids such as blood or urine are integrators of exposures from all routes, biological monitoring alone does not allow researchers or policy makers to understand which route(s) or sources contributed to exposure. Biological monitoring is most useful when combined with corresponding human activity, environmental concentration and source information so that the causes of high exposures can be identified and prevented.
Research Approach	In the Minnesota study, morning urine samples were collected from a sample of children and analyzed for selected pesticide metabolites. The population was limited to households with children, ages 3-12 years, in urban and non-urban areas in Minnesota. Selected households included more homes which reported frequent use of pesticides for insect control. Pharmacokinetic (PK) models can predict the internal doses of chemicals via ingestion, inhalation, and dermal contact. An "inverse" PK model was used to estimate absorbed dose based on the amount of a metabolite in the urine. Since exposures from different routes may lead to the same dose, questionnaire and environmental monitoring data were used to help solve the "inverse" PK models and predict the chlorpyrifos dose and the types of exposures that may account for this.
Results and Implications	The major metabolite of chlorpyrifos, a commonly used insecticide, was present in 98% of the participating children's urine samples. Its concentrations were higher in urban than in non-urban children, and were about twice as high as those measured for adults in previous studies. The "inverse" PK model predicted the dose resulting both from specific pesticide exposure events and from average low-level exposures. This dose was similar to what has been estimated for

children following indoor insecticide treatments. It was lower than previously reported exposure measurements made in adults who were actively moving on freshly treated grass. This model may prove to be a useful method of "disaggregating" exposure estimates based on biological monitoring and limited survey data in future exposure studies.

The results of this project address Government Performance and Results Act (GPRA) Goal #3 (Safe Food), Subobjective 3.2.4 (By 2005, provide problem-driven research results to support the new FQPA regulatory standard of "reasonable certainty of no harm" for pesticides used on food). The results of this project address GPRA annual performance goal (APG) 13 ("In 2001, develop pesticides exposure and effects data, risk assessment methods and models for children, and control technologies needed to comply with the requirements of FQPA"), annual performance measure (APM) 148 ("Report on aggregate exposure of children in Minnesota to pesticides, identifying which pathways contribute most to exposure."). Although this work directly supports a Goal 3 APM, the results also will be valuable to reduce uncertainties in exposure assessment under Goal 8.

Research Collaboration and Publications

The Minnesota Children's Pesticide Exposure Study was conducted in collaboration with the Research Triangle Institute (RTI) and Environmental and Occupational Health Sciences Institute (EOHSI), the Minnesota Department of Health, and the University of Minnesota. This research has been published in the following manuscripts:

Rigas, M.L., Okino, M.S., Quackenboss, J.J. "Use of a Pharmacokinetic Model to Assess Chlorpyrifos Exposure and Dose in Children, Based on Urinary Biomarker Measurements." *Toxicological Sciences* 61:374-381, 2001.

Adgate, J.L., Barr, D.B., Clayton, C.A., Eberly, L.E., Freeman, N.C.G., Lioy, P.J., Needham, L.L., Pellizzari, E.D., Quackenboss, J.J., Roy, A., Sexton, K. "Measurement of Children's Exposure to Pesticides: Analysis of Urinary Metabolite Levels in a Probability-Based Sample." *Environ Health Perspect* 2001; 109:583-590.

The design of the Minnesota study is described in:

Quackenboss, J.J., Pellizzari, E.D., Shubat, P., Whitmore, R.W., Adgate, J.L., Thomas, K.W., Freeman, N.C., Stroebel, C., Lioy, P.J., Clayton, A.C., Sexton, K. "Design strategy for assessing multi-pathway exposure for children: the Minnesota Children's Pesticide Exposure Study (MNCPES)." *J Expo Anal Environ Epidemiol* 10:145–158 (2000).

Future Research

Future analyses of the NHEXAS data will be based on the projects included in the Strategic Plan for Analysis of the NHEXAS Pilot Study (EPA 600/R-00/049), which is available at http://www.epa.gov/nerl/research/nhexas/strategy.pdf

Contacts for Additional Information

Questions and inquiries on NERL's research to analyze the results of the NHEXAS and Minnesota Children's Pesticide Exposure Studies can be directed to:

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